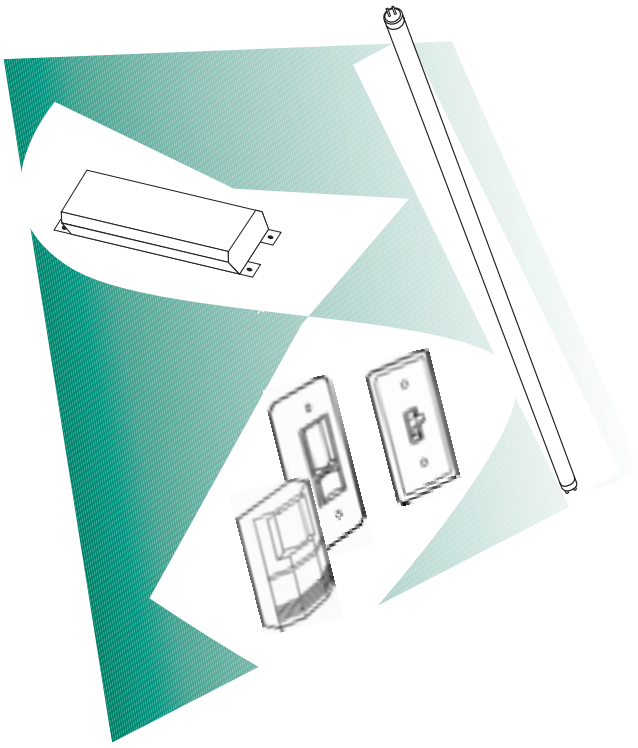
NATIONAL LIGHTING PRODUCT INFORMATION PROGRAM

Guide to Selecting Frequently Switched T8 Fluorescent Lamp-Ballast Systems



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Synopsis

- Instant-start electronic ballasts for T8 lamps require less power than either rapid-start electronic or rapid-start magnetic ballasts.
- NLPIP found no evidence to support the common belief that, when operating cycles are short, rapid-start electronic ballasts for T8 lamps provide longer lamp life than instant-start electronic ballasts.
- NLPIP found evidence to support the use of a new metric, the Rh/Rc ratio, as a predictor of lamp mortality for lamps operated on electronic rapid-start ballasts in frequent-switching applications.

Overview

This *Guide to Selecting Frequently Switched T8 Fluorescent Lamp-Ballast Systems* is intended to help specifiers select appropriate fluorescent lamp-ballast systems by helping them understand how different ballast types affect lamp operating life when the lamps may be switched frequently, such as in occupancy sensor applications.

Manufacturers base their life ratings of fluorescent lamps on a test cycle in which lamps operate for 3 hours (h), then are turned off for 20 minutes (min). This cycle may be unrepresentative of actual installations, such as those in which an occupancy sensor controls a lighting system and lamp switching is irregular and frequent. Starting voltages damage the electrodes of a fluorescent lamp, so frequent switching reduces lamp operating life. Many specifiers believe that rapid-start ballasts damage electrodes less during starting than instant-start ballasts because they heat the lamp electrodes and therefore apply a lower voltage to start the lamps.

Instant-start ballasts apply a starting voltage of more than 400 volts (V) to the cold electrodes to strike the arc. Rapid-start ballasts, however, provide a low voltage (about 3.5 V) to heat the lamp electrodes to between 700–1000 °C in 1–2 seconds while applying a starting voltage of only 200–300 V.

Most rapid-start ballasts continue to heat the electrodes after the lamp has started, which results in additional power requirements of approximately 2–4 watts (W) per lamp.

NLPIP's Findings

NLPIP tested the starting and operating characteristics of seven 2-lamp F32T8 ballasts from three manufacturers.[1] NLPIP obtained 27 samples of three rapid-start electronic ballasts, two instant-start electronic ballasts, and two rapid-start, energy-efficient magnetic ballasts. Each ballast type was tested using an equal number of lamps from three lamp companies. All the ballasts met the specifications of the American National Standards Institute(ANSI).

The table shows that the magnetic ballasts had the lowest system efficacies and that the instant-start electronic ballasts had greater system efficacies than the rapid-start ballasts because of their lower active power.

NLPIP tested the lamp-ballast systems using a rapid (5 min on-5 min off) cycle, and the industry-standard 3 h on-20 min off cycle. Results of the rapid-cycle tests are provided in both the table and the figure. NLPIP has not yet completed tests using the industry standard cycle.

In NLPIP's rapid-cycle tests, the two rapid-start magnetic ballasts (F and G) produced very short lamp operating lives relative to the other types of ballasts. One of the rapid-start electronic ballasts (A) provided substantially longer lamp life than any of the other ballasts. The other two rapid-start electronic ballasts (B and C) did not produce longer lamp operating lives than the instant-start ballasts (D and E).

In its rapid-cycle tests, NLPIP also determined the ratio of hot electrode resistance to cold electrode resistance (Rh/Rc) for each lamp-ballast system, as a predictor of electrode temperature immediately before a lamp is started. ANSI is currently considering Rh/Rc as a new metric to be used to determine whether rapid-start lamp-ballast systems adequately heat the lamp electrodes before starting. An Rh/Rc value of 4.25 equates to a lamp electrode temperature of 700 °C, which lamp experts consider the minimum temperature for proper lamp starting. In NLPIP's test, only ballast A met this criterion; ballasts B and C had lower Rh/Rc values.

Performance of T8 Fluorescent Lamp-Ballast Systems Operating in Rapid-Cycle Tests

Ballast Operating Two 4-foot, 32-watt T8 Lamps

Ballast Type	Ballast ID	Starting Method	System Active Power (W)	Ballast Factor	System Efficacy*	Median Test Cycles	Median Test Hours	Rh/Rc
Electronic	A	Rapid Start	60	0.86	85	43,274	3606	4.25
Electronic	B	Rapid Start	60	0.87	85	15,732	1311	3.25
Electronic	C	Rapid Start	62	0.88	84	11,977	998	2.75
Electronic	D	Instart Start	58	0.89	90	13,514	1126	NA**
Electronic	E	Instart Start	59	0.90	91	19,417	1630	NA**
Magnetic	F	Rapid Start	71	0.97	81	3118	260	NT***
Magnetic	G	Rapid Start	72	0.98	80	2807	234	NT***

*System efficacy = (lamp lumens × ballast factor) / system active power (assumes rated light output for a T8 lamp is 2950 lm)

** Not Applicable

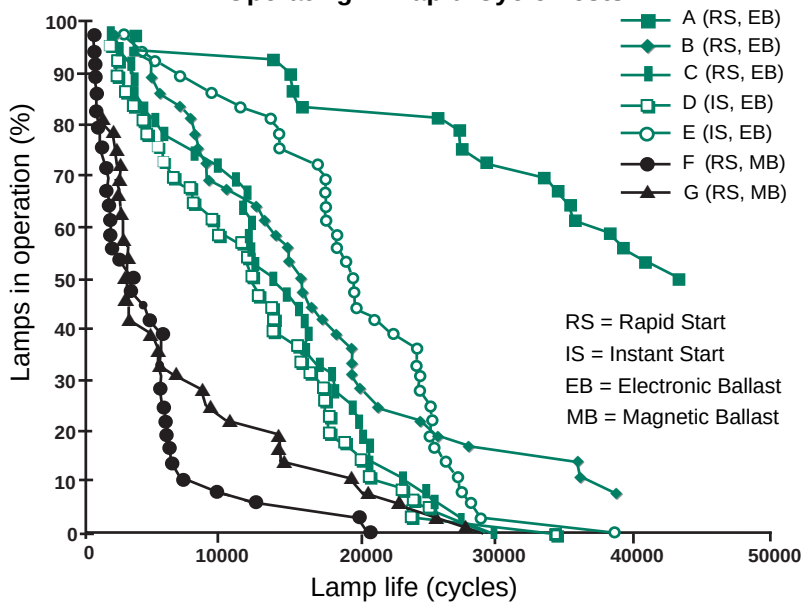
***Not Tested

NLPIP believes that the lower Rh/Rc values for ballasts B and C indicate that those lamp-ballast systems did not produce longer lamp operating life because they did not provide sufficient heat to the lamp electrodes to minimize damage during starting.

Using Rh/Rc

Ballast manufacturers have begun to introduce products that use a different starting technique, called program start by some, to ensure adequate electrode heating prior to starting. NLPIP expects that lamps operating on these ballasts will have life similar to those operated by ballast A if they have Rh/Rc values of at least 4.25. Specifiers who wish to consider Rh/Rc along with other starting and operating metrics when specifying either program-start or rapid-start ballasts should call the ballast manufacturer to request the Rh/Rc for a given lamp-ballast system. In the absence of this information, specifiers should not differentiate between rapid and instant-start ballasts based on life. Instead, specifiers should consider other factors, including active power, system efficacy, and cost.

Operating Life for T8 Fluorescent Lamp-Ballast Systems Operating in Rapid-Cycle Tests



[1]Ji, Yunfen, Robert Davis, Conan O'Rourke, and Edmond Chui, *Compatibility testing of fluorescent lamp and ballast systems.* 1997. Proceedings of the IEEE-IAS Annual Conference. October.

More Information

To obtain information on other publications from the National Lighting Product Information Program, please contact the Lighting Research Center, Rensselaer Polytechnic Institute, 110 8th Street, Troy NY 12180-3590, phone (518)276-8716, fax (518)276-2999, e-mail lrc@rpi.edu, Web site www.lrc.rpi.edu

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